S4 Photosynthesis

While humans and animals eat plants and other animals as food, plants can make their food using light and a process called photosynthesis. Photosynthesis is the process in which plants make food using carbon dioxide, water, and sunlight. While the process can be complicated, it can be simply written with the following word equation:

Photosynthesis happens in the leaves of the plants where chloroplasts live in cells. There are two stages in photosynthesis. The first stage needs light, and the second stage does not.

Just like humans, plants are made up of thousands of cells. Unlike animal cells, plants have a special structure called chloroplasts where photosynthesis happens. Chloroplasts are tiny oval-shaped blobs found inside plant cells. Sometimes plant cells only have a few chloroplasts while others take up the whole space inside a cell. Chloroplasts have many layers. The outer layer is smooth while the inside of the chloroplast contains several important pieces.

Inside the chloroplast is a collection of sacks full of chlorophyll called thylakoids that float in a fluid called stroma. Thylakoids look like stacks of pancakes. Chlorophyll gives plants their green color and helps plants absorb energy from the sunlight.

Stage One: Light-Dependent Reactions

The first stage of photosynthesis is called the light-dependent reactions stage. This stage happens in the thylakoids of chloroplasts and can only happen when sunlight is available.

- Sunlight hits the chlorophyll in the chloroplasts and excites electrons.
- The excited electrons break free from the chlorophyll.
- Since one electron just left the chlorophyll, it must be replaced. A molecule of water is split into oxygen (O2) and a hydrogen ion (H+) in the thylakoids.
- The free electrons then undergo a chemical reaction to create ATP and NADPH, which are both energy molecules needed for the second stage of photosynthesis.

Stage Two: The Calvin Cycle

The second stage of photosynthesis, called the Calvin Cycle, occurs in the stroma of chloroplasts. Sunlight is not needed for the Calvin Cycle. Carbon dioxide and energy from ATP and NADPH create glucose. Glucose is a simple sugar which plants store as energy and can be converted to other components like starch and cellulose that are important to cell structure.

- Carbon dioxide from the air is absorbed through holes in the leaves of the plant.

- The carbon dioxide molecule binds to a simple sugar called RuBP.
- Through a four-step chemical reaction, carbon dioxide, and RuBP molecule combine with ATP and NADPH from the first stage to create a molecule of glucose.

Photosynthesis is the backbone of life on Earth. Humans cannot live without oxygen. The oxygen plants produce during photosynthesis is released into the air people breathe every day. As people breathe in oxygen, they release carbon dioxide. Plants use carbon dioxide in the process of photosynthesis. Thus, plants are responsible for balancing the oxygen and carbon dioxide levels in the air. In addition, some plants store the glucose produced during photosynthesis in fruits and roots. Some of these fruits and roots are apples, carrots, strawberries, and other delicious foods people enjoy eating.